Discover Plants

Review

Therapeutic use of plant parts as food or medicine at succulent state: an alternative healthcare system for the prevention and treatment of diseases

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Abstract
The disease can be considered as an outcome of factors such as genetics to the overall lifestyle including the food intake habits of the individuals. In contemporary healthcare systems, treatment is possibly given more importance than the prevention of diseases. Therefore, research for concrete diagnosis and drug-based treatment of diseases has formed the two prime ways to explore more effective therapy for diseases. Like edible fruits, the succulent parts of medicinal plants contain the highest number and quantity of effective phytoconstituents that work in conjunction to exert beneficial effects on health. To strengthen the disease-preventive ability and modulation of the body's immune power, along with the inclusion of some beneficial practices in the lifestyle, oral intake of succulent biomedicines could be effective. Some of them could supplement as a part of the daily planned diet and others can be taken to treat specific diseases. This article presents an overview of succulents that can be used to control infectious and lifestyle diseases like diabetes and cancers. With judicious application of the cold chain systems, bio-preservatives can be added, and bio-encapsulated succulent biomedicines, once prepared, can be made available throughout the globe to patients or consumers. This article is also an attempt to present the main features of the novel alternative healthcare system that incorporates the typical use of medicinal plants in light of the perception of modern medicine.

Keywords Healthcare system · Designed lifestyle · Vegetable salad · Fruit salad · Nut mixture · Spice mixture · Succulent biomedicine capsule · Global transport

1 Introduction

In modern medicine and most parts of the alternative medicine systems, diagnosing diseases and their treatment is considered the area of sole investment and study. Except for vaccination, no other ways are properly studied and effectively used for the prevention of diseases [1–3]. Vaccination can cover and control only a limited section of diseases of infective origin and another very limited number of diseases of other origins. Modern techniques of the use of genetic knowledge of the organisms in vaccine preparation are not above doubts and questions of their actual impacts on health [4, 5]. On the other hand, a large portion of modern treatment is engaged mainly to control the expressed symptoms and related discomfort of the patients [6, 7].

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Expression of disease symptoms by one individual depends on many factors. Recent research identified some new mechanisms working behind the development of a disease and the expression of its symptoms.

The genetic status of an individual plays a great role in the development of a disease, but some other important factors influence even the expression of genetically predisposed diseases. Such factors are controlled mainly by different lifestyle parameters [8–10]. The 'Unique Disease Principle' indicates the interaction of different exogenous and endogenous factors with other environmental influences leading to heterogeneity of the disease process at the individual level. The status of immunity, the internal condition of the body, and the microbiome profile at the individual level are considered the main influencing factors to create diseases in the Molecular Pathological Epidemiology (MPE) concept [11–13]. So, apart from genetics, the actual health status of any individual and susceptibility to different diseases as well as aging - all are dependent on important factors like biological age, environmental conditions, and the past and present lifestyle practices at the individual level [14–16].

The subject 'epigenetics' deals with the environmental influences on the genes for their expression and proper working [10, 17, 18]. The epigenetic influences are responsible for the expression of genetic predisposition to any noticeable disease.

Along with these areas of research, the effect of following a designed lifestyle and the use of plant parts in their nature-derived state as food and non-food medicinal items are also identified as some decisive factors behind the expression of disease [19, 20]. Due to a very low level of link with the presently practiced healthcare systems, that particular area of research is considered a separate healthcare system by some researchers working in that field [21–23].

Knowledge about the use of plant parts in healthcare has come to us mainly through codified systems like *Ayurveda*, *Unani*, *Chinese medicine*, etc. as well as by noting such uses by the ethnic and rural people of the world. It is assumed that the practice of using plant parts as some medicine is very old, perhaps started before the development of the human species, as such uses are still found in different species of animals distant as well as genetically very close to the human being [24]. They never store any plant parts for future use and generally use them in their succulent state. Ethnic people in remote parts of the world are continuing such practices, and in many cases, they are accustomed to the use of plant parts for medicinal purposes in their raw, succulent state [24, 25]. But in the codified systems, perhaps due to problems like seasonal and regional availability, lack of facilities for distant transport, storage, etc., use of the medicinal plant parts was mainly restricted in their dried state [22, 26].

In modern medicine, a significant portion of synthetic drugs is developed from herb sources [24, 26]. A common analytic procedure is generally followed in searching for such medicines. Methanol, ethanol, acetone, etc. solvents are used on the dried and powdered parts of the reported medicinal plants to get extract from them. After testing their reported efficacies, analysis of these extracts is performed to get some active principle/s with a target of synthesizing them artificially at a bulk quantity to use them as some marketable drugs [6, 22].

However, this contemporary and widespread system of validation of reported efficacies of the medicinal plant parts and searching for a few effective and nontoxic chemicals from them has many conceptual limitations. The entire system is criticized for giving importance only to the identifiable phytochemical/s act singly without considering the combined efficacies of all the phyto-constituents present in the study parts of the medicinal plants, and the succulent parts of the plants contain the highest quantity and qualities of active phyto-constituents that can act together to show their efficacies. There is perhaps some sort of influence of one phyto-constituent on others and ultimately the modified and combined effects of all of them are expressed. In the dried condition, only a very limited part of them are available and the diluents can identify only a section of them during extraction. On the other hand, a maximum portion of such isolated phytochemicals or their synthetic analogs are found toxic in the possible therapeutic doses, which may be due to the same reasons [12, 21].

The use of specific plant parts as some food items for all individuals to strengthen the immunity status of the body and the use of some other plant parts selectively and specifically for prevention and control of different diseases can be an effective alternative to combating diseases with synthetic chemicals - as unlike the succulent plant parts, none of such synthetic substances are accustomed to the body during the entire evolutionary period of the humankind. Along with following a lifestyle that incurs positive effects on the body, using such plant medicines in a succulent state can combat diseases of both infectious and non-infectious origins [12, 27].

2 Contemporary and emerging health problems

Along with rapid development and use of technologies as a part of modernization, different new problems are also continuously added in different aspects of our lives, including our health and disease susceptibility [28, 29]. The development of resistance among the microorganisms is making antimicrobials ineffective [27]; induced modification in the genome of the microorganisms by human intervention for the preparation of vaccines and other purposes is perhaps converting them into some dangerous threats to human civilization in many cases [5, 30]. Weakening of the immunity system of the body and the creation of an environment favorable to catching more and more infections as an outcome of following a wrong lifestyle; development of different lifestyle diseases (from different hypersensitivity diseases, diabetes, cardio-respiratory diseases, liver and kidney diseases, metabolic diseases like polycystic ovarian disease, chronic obstructive pulmonary disease, diseases due to hormonal imbalances up to different cancers), etc. are some such new problems accelerating at a great speed nowadays among the population [5, 31, 32].

3 Lifestyle and disease development

3.1 Processed and technology-derived foods and food items

Nature-derived food items are not truly nature-derived nowadays, as the use of different chemical pesticides, fertilizers, etc., and the presence of residue of these synthetic toxic chemicals in food items of both plant and animal origin are widespread. Along with these residues in the basic food items, a huge number of synthetic chemicals of different names (from added preservatives, stabilizers, coloring material, different adulterating chemicals, etc. up to the leached plastic additives of the packaging) and other materials (as excess nasty fats, salt, sugar, etc.) are added in these technology-derived foods before human consumption. We have almost no idea about the health impacts of long-term continuous use of these synthetic chemicals at the collective and cumulative condition inside our body [20, 21, 32].

3.2 Healthcare products and cosmetics

The drugs developed and used in modern medicine are all of synthetic origin. Like the technology-derived foods, many so-called healthcare products and cosmetics (even the so-called herbal products) available for use under different categories and names are mainly of synthetic and semi-synthetic origin. Like the chemicals added to processed foods, we have no idea about the health impacts of such chemicals in their long-term, continuous use [19, 21, 33].

After intake of all such synthetic chemicals (added chemicals of processed foods and drinks, cosmetics, sprays, etc. up to modern medicines) as some food or non-food items through the mouth, skin, lungs, etc., possibly a portion of the chemicals, its metabolites or their effects remain in the body system to exert their detrimental activities in future. They possibly exert their effects cumulatively and collectively and in that way, they can trigger different predisposed diseases and/or can create an environment in the body to invite many other diseases like cancers, hypersensitive diseases, hormonal imbalance-induced diseases, etc. [31, 32].

3.3 Importance of following a designed lifestyle for the prevention of diseases

Reduction of negative influences and addition of positive influences by modification of the contemporary ideas related to health, and changing the wrong practices are the key factors for staying in good health with disease-free conditions. Abstaining from all synthetic chemicals of all types and categories; staying away from all processed foods and chemical-added drinks, narcotics, tobacco, and alcohol; rational and limited exposure to modern diagnostics like scanning or X-ray exposure as well as rational use of modern medicines, etc. are considered as a very important aspect in this regard [32].

Following a designed and regular lifestyle with physical and mental exercises (like maintenance of body clock, regular exposure to sunlight, physical exercise from walking, swimming to attending gymnasiums, removal of stress by activities like yoga, mental relaxation by spending time with nature without any electronic gazettes, spending time with children,

pet animals, and birds, etc.) can create the basis of the proper positive environment inside our body system and it is considered as the basis of good health [31, 34, 35].

Some identified lifestyle-related factors involved in the creation of diseases are stated along with the ways to overcome their effects are discussed in Table 1.

4 Effective uses of food and non-food edible plant parts in combating diseases

4.1 Reported activities of the succulent parts of the medicinal plants against important diseases

Reports related to the use of different parts of the medicinal plants (root, stem, fruit, leaf, flower, etc.) as some preventive or curative medicines are available. In most cases, these can be used in their succulent state therapeutically.

4.1.1 Anti-diabetic plants

Almost 800 plants are identified for their anti-diabetic activities [36] and different parameters related to their possible use in a succulent state are also studied [31].

4.1.2 Anti-cancer plants

There are identified 934 plants with the description of their different use-related parameters like parts of the plant to be used, their possible safety grade, etc. [32].

4.1.3 Plants with immune-modulation activities

A total of 130 plants are identified and listed for their reported immunomodulation activities [7].

4.1.4 For treatment of diseases of infective origin

Nearly 1200 plants are identified and listed for their reported efficacies to combat infection of many important disease-causing organisms [21, 27].

4.1.5 For viral diseases like Covid 19

Seventy-eight (78) plants are identified for their possible antiviral efficacies [30, 37].

Many plants are common in these lists. So, it can be assumed that they can act against a wide number and types of diseases together. As it is a novel idea, detailed adoptive research is required before the widespread use of these as effective biomedicines.

4.2 Inclusion of some edible plant items in the daily diet

Regular intake of a few dry fruits, nuts, succulent vegetables, and spices can keep the basic health status in a very good condition. A few such plants are listed for initial consideration for application of the concept. The number and combination of the plant parts and the approximate quantities added to the list are to be modified after appropriate scientific studies.

4.2.1 Intake of dry fruit and nut mixture

A mixture of the following dry fruits, nuts, etc. can be prepared and preserved for a few days. Proper cleaning and washing of the items before use is very important.

(i) Almond (*Prunus amygdalus* Batsch, Family: Rosaceae) 5–6 piece; (ii) Date (*Phoenix dactylifera* L., Family: Arecaceae) 2–3 piece; (iii) Apricot (*Prunus armeniaca* L. Family: Rosaceae) 2–3 piece; (iv) Cashew nut (*Anacardium occidentale* L. Family: Anacardiaceae) 4–5 piece; (v) Pistachio (*Pistacia vera* L., Family: Anacardiaceae) 4–5 piece; (vi) Raisin (*Vitis vinifera* L. Family:

Table 1 Some identified lifestyle related factors supposed to involve in creation of diseases

Factors, and nature of the items identified	Health impacts	Reference
1. Processed foods: a) Prepared by hydrogenated vegetable oils containing trans-fats	Raise LDL and VLDL, inter-cellular adhesion molecule-1, vascular-cell adhesion molecule -1, E-selectin, and lowers HDL and CRP, leading to the development of atherosclerosis. Increases the risk of coronary heart disease, insulin resistance leading to Type 2 diabetes. Related to pre-eclampsia; shortening of the pregnancy period, ovulatory infertility, and low birth weight babies Development of breast cancer and colon cancer: allergy-associated diseases (asthma, asthmatic eczema, allergic colds, etc.), among growing children. Disorders of the nervous system, eyes of children, Alzheimer's disease, liver dysfunction, etc.; obesity and rapid weight gain.	[2, 53–59] [59–63] [60, 64, 65] [60, 66, 69]
b) Deep/repeated heating at very high temperatures (above 180 °C)	Oxidation, hydrolysis, isomerization, polymerization of the food ingredients happens; develop oxidized triacylglycerol monomers, hydrolysis products, cyclic compounds, trans configuration compounds, sterol derivatives, polymers, acrylamide, nitrogen- and sulfur-containing heterocyclic compounds, etc., having negative impacts on health.	[70, 71]
c) Added food additives (preservatives, stabilizers, sweeteners, etc. (more than thirty), artificial colors (more than fifteen), etc.)	Digestive problems, headaches, hypersensitivity diseases, asthma, skin problems, disruption of hormonal balance, obesity, liver and kidney problems, insulin resistance and type 2 diabetes, respiratory diseases, nerve-related diseases, cardiovascular diseases, birth defects, and different kinds of cancers, etc.	[19, 22]
2. Micro and nano-plastics and plastic additives: Plastics: in drinking water, packaged food-drinks, etc. Additives: Bisphenol A, brominated flame retardants, phthalates, some heavy metals, and coloring materials	Micro and nano plastics have reached different internal organs, the placenta, etc.; they can cause type 2 diabetes, cardiac diseases, and inflammatory diseases; they cause oxidative stress, cellular damage, neuronal disorders, inhibit acetylcholine esterase, and bring behavioral changes. Additives: Leaching of residual monomers (polyurethanes, polyvinyl chloride, epoxy resins, and styrene polymers); behaving like carcinogens (butadiene, vinyl chloride, etc.), mutagens (phenol, benzene, etc.); cancers, disrupt immune system; cause PCOS, infertility, inflammatory diseases, obesity, improper glucose metabolism, insulin resistance to type 2 diabetes, etc.	[72–74, 77, 80–84] [72–76, 78, 79, 85–86]
3. Non-exposure to Sunlight: Vitamin D deficiency	Deficiency of vitamin D is pandemic; food sources are very low, synthetic vit. D not properly acting; cause rickets, osteoporosis, osteopenia, easy fractures; autoimmune diseases, hypertension, different infectious diseases, diabetes, and cancers.	[87–90]
4. Continuous engagement in electronic gazettes: A common practice among the people	Musculoskeletal disorders, repetitive strain injury, damage of muscles, tendons, and nerves of neck, shoulder, forearm, and hand; pain, numbness, weakness, and impairment of motor nerve control. Affect eyes, become psychologically separated.	[87–92]
5. Violation of the body clock (circadian clock) and staying in stressful condition; irregular lifestyle	Circadian rhythm disorders lead to various physical and psychological problems; causes headache, depression, anxiety, cardiovascular diseases, asthma, diabetes, obesity, Alzheimer's disease, gastrointestinal problems, acceleration of aging, premature death, etc.	[93–98]
6. Irrational use of synthetic drugs and exposure to irradiation	Self-medication is seen more among educated and females; toxicity in irregular use; irrational use of radiation can cause cancers and many other diseases.	[2, 28, 32, 99–101]

LDL Low density cholesterol, *VLDL* Very low density cholesterol, *HDL* High density cholesterol, *RBC* Red blood cells, *CRP* C-reactive protein, *PCOS* Polycystic Ovarian Syndrome

Vitaceae) 8–12 piece; (vii) Walnut (*Juglans regia* L. Family: Juglandaceae) 1–2 piece; (viii) Anjir (*Ficus carica* L. Family: Moraceae) 1–2 cut piece; (ix) Flaxseed (*Linum usitatissimum* L. Family: Linaceae) 3–4 g; (x) Chia seed **(***Salvia hispanica* L. Family: Lamiaceae) 2–4 g, etc. [21, 22, 32].

4.2.2 Intake of a mixture of some succulent vegetables in the form of salad

4.2.2.1 Separate intake of the following vegetables can be performed after proper cleaning (i) Turmeric (*Curcuma longa* L. Family: Zingiberaceae) 4–5 g in morning (ii) Lemon (*Citrus* × *limon* (L.) Osbeck, Family: Rutaceae) 50–100 drops with water anytime.

4.2.2.2 A mixture of the following vegetables can be prepared for pre-breakfast intake The vegetables may be cut into small pieces after proper cleaning, washing, and removal of the covering layer before use.

(i) Carrot (*Daucus carota* subsp. *sativus* (Hoffm.) Schübl. & G. Martens, Family: Apiaceae) 15–25 g; (ii) Beetroot (*Beta vulgaris* L. Family: Amaranthaceae) 10–15 g; (iii) Cucumber (*Cucumis sativus* L., Family: Cucurbitaceae) 20–40 g; (iv) Garlic (*Allium sativum* L., Family: Amaryllidaceae) 2–4 piece; (v) Ginger (*Zingibe rofficinale* Roscoe, Family: Zingiberaceae) 2–3 g; (vi) Green chili (*Capsicum annuum* L., Family: Solanaceae) ½ to 1 piece; (vii) Onion (*Allium cepa* L. Family: Amaryllidaceae) 10–15 g; (viii) Tomato (*Solanum lycopersicum* L., Family: Solanaceae) 10–15 g; (ix) Radish (*Raphanus sativus* L. Family: Brassicaceae) 10–20 g; (x) Lettuce (*Lactuca sativa* L., Family: Asteraceae) 3–5 g, etc. [21, 31, 32].

The selection of succulent vegetables may vary for the prevention of specific diseases and individual requirements. A total of 124 vegetables are listed for their ability to prevent diseases like cancers. These have such preventive effects against many other diseases also [32].

4.2.3 Mixture of succulent fruits

Selection of a few seasonal fruits may be performed as per their availability. Names of 124 succulent fruits are listed for their possible anticancer capabilities [32]. All such fruits have the same type of effects to combat a huge number of other diseases. Depending on the seasonal and regional availability, a mixture of 10–12 fruits can be taken in the afternoon after converting them into some small pieces.

4.2.4 Mixture of some edible spices

Dry powder of a few spices can be taken once or twice per week. Names of some commonly available spices are identified for that purpose.

(i) Clove (*Syzygium aromaticum* (L.) Merr. & L. M. Perry, Family: Myrtaceae) 1–2 piece; (ii) Coriander (*Coriandrum sativum* L. Family: Apiaceae) 3–4 piece; (iii) Cumin (*Cuminum cyminum* L. Family: Apiaceae) 8–10 piece; (iv) Black caraway (*Nigella sativa* L., Family: Ranunculaceae) 20–40 piece; (v) Cinnamon (*Cinnamomum verum* J. Presl Family: Lauraceae) 2–3 g; (vi) Fenugreek (*Trigonella foenum-graecum* L., Family: Fabaceae) 15–25 piece; (vii) Black pepper (*Piper nigrum* L., Family: Piperaceae) 2–3 pieces; (viii) Ajwain (*Trachyspermum ammi* (L.) Sprague ex Turrill, Family: Apiaceae) 15–25 piece; ix) Fennel seed (*Foeniculum vulgare* Mill., Family: Apiaceae) 15–25 pieces, etc. [21, 31, 32].

4.2.5 Alteration of food items in the diet

Frequent alteration of food items in the diet can increase attraction to the food and add benefit to the health. Different fruits, vegetables, cereals, pulses, etc. contain different vitamins, minerals, antioxidants, etc. required for health. Different pulses have different combinations of amino acids required to fulfill our protein demand. The same can be said for mushrooms, peas, milk, meat, egg, fish, etc. food items, and all are beneficial to the body system [22, 38].

5 Global, all-season availability and use of succulent fruits, nuts, spices, vegetables, and biomedicines

As a novel idea, the succulent parts of the medicinal plants are proposed for their effective and therapeutic use directly without any modification. The succulent vegetables, fruits, dry nuts, spices, etc. can also be encapsulated for all-season availability to everybody through global transport like the succulent biomedicine capsules following the same basic principles, techniques, and procedures [26, 31, 39].

For this, validation of the reported use of the medicinal plants and then their medicinal use requires some important conceptual modification as stated in Table 2 [24].

The limitations faced by the ancient physicians during the preparation, storage, and transportation of herbal medicines are not relevant now. The seasonal and regional availability of the plant parts, possible spoilage of them during storage or transportation, etc. can easily be overcome by the effective use of cooling techniques [7, 30, 39].

5.1 Widespread therapeutic use of succulent biomedicines in the capsular form

Cultivation of the plants to get succulent biomedicines can be performed in their natural or near-natural soil and climate, to be collected scientifically and encapsulated by bio-encapsulating materials after the addition of bio-preservatives, and can be transported throughout the globe to the consumers or patients under proper cold chain (Table 3) [31, 32]. A list of different bio-preservatives for their effective use in succulent biomedicines, different useable non-synthetic bio-encapsulating materials, as well as specific technical use of the cold chain systems with monitors and spoilage indicators at different stages of preparation, transport, and storage of succulent biomedicines are added and discussed in some published literature [21, 22, 37]. A few models of bio-encapsulation techniques of the succulent bio-medicines, their packaging, and storage in the specialized devices before dispensing are also advocated (Figs. 1 and 2) [30–32].

6 Possible mechanism of activity of the succulent biomedicines

In the succulent condition, the edible plant parts (such as fruits, vegetables, etc.) contain a huge number of phytoconstituents. It is not easy to identify their activities from the published research works. The study report of succulent extracts of the plants is scarce.

6.1 Phytoconstituent/s, their identification, and expression of activities singly and cumulatively

In contemporary research, study reports related to the combinational effect of different phytoconstituents available in the dry parts of the plants are also very low in number. If only antioxidation, a well-known idea of modern medicine is considered, it is found that the antioxidants present in many such plant-derived foods can prevent different diseases. Antioxidants act mainly either by detecting and preventing the chains of oxidative propagation or by controlling and stabilizing scavenging activities of the single atom oxygen (termed as free radicals) developed during aerobic metabolism. Thus oxidative damage of the body system is managed [39–42].

Among the identified antioxidants of edible plant items, carotenoids, phenolic compounds, etc. are known terms to many of the researchers. There are identified carotenoids of nearly 1000 in number and over 400 flavonoids, more than 8000 plant phenols, and many other compounds like benzoic acid derivatives, proanthocyanins, coumarins, stilbenes, lignin, lignans, etc. are known and covered under this category. All these antioxidants follow separate mechanisms to

Table 2 Conceptual shifting of study for validation of medicines for development of succulent biomedicines is required

Presently practiced pattern followed for the development of modern medicines from herbal sources:
Diluent extraction/ chemical extraction from dry plant parts, and other sources → active ingredient isolation → Structural analog manufacturing → Safety and efficacy study → proceeding towards the development of marketable medicines
↓ Shifting
A new pattern may be followed for Succulent bio-medicines:
Succulent biomedicines → in vivo and/or in-patient study for validation of efficacy → dose and safety study → chemical composition analysis (if not already known) → proceeding towards the development of marketable medicines by bio-encapsulation

Table 3 Production and transport of proposed succulent biomedicines

Identification of the effective plants to get succulent biomedicines for the intended purpose/es
↓
Validation of reported activities of the medicinal plant/ plant parts by in vivo models or directly on patients
↓
Standardization of dose and measurement of toxicity level, mainly on models or by using animals
↓
Preparation of a database about the main phytoconstituents present in plant parts and preparation of a standard chart of it from the available resources for each effective plant medicines
↓
Standardization of packaging-related parameters like bio-preservatives, bio-encapsulation, spoilage indicators, etc. for each medicine
↓
Planning for the production of the medicines at a large scale
↓
Cultivation of plants in their near-natural environment and soil
↓
Collection of succulent plant parts/fruits/dry seeds, etc
↓
Quality testing and calculation of quantity per dose by measuring main constituents available in each lot/a batch of raw materials by comparing with a standard chart and then mixing raw materials of different sources as per the requirement
↓
Preparation of pulp-paste or extraction of juice of succulent plant parts or fruits/ preparation of powder of dry seeds, etc
↓
Concentration or dilution of the pressure extracts (juice)/ mixing of a few biomedicines together/ making block or capsule of powders prepared from the dry biomedicines/ addition of the bio-vehicle/s with the medicines, etc. (as per requirement)
↓
Addition of bio-preservative/ bio-coating in/on the biomedicines (as per requirement)
↓
Encapsulation of the medicine (pulp/juice/powder etc.) inside digestible/ harmless biological capsular materials for oral use
↓
Addition of spoilage indicator/s on the packets of the biomedicines (as Vaccine Vial Monitor chemicals)
↓
Transportation through the cold chain (at different temperatures at different stages) up to the patient level
↓
Intake of the biomedicines at encapsulated condition or after removal of covering and bringing the temperature of the medicines near 25 ℃ just before use by use of warm water, etc

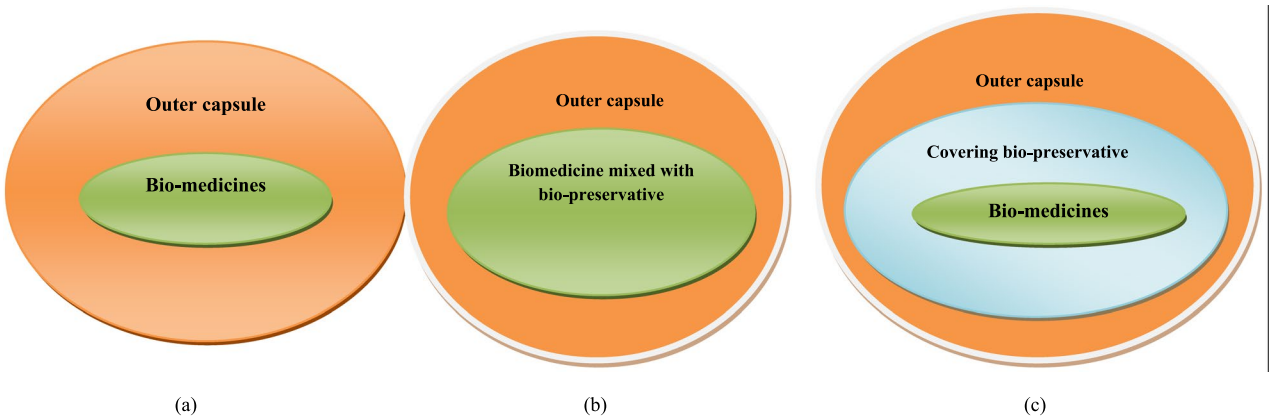


Fig.1 Three different models of succulent biomedicine encapsulation (**a**–**c**)

act. It is also important to note that intake of a single type of antioxidant in large amounts is not profitable to our body system; rather regular intake of different antioxidants is the only way to get the best benefit [37, 43, 44]. As all medicinal plant parts contain a huge number and type of phytoconstituents, the study of their combinational effects appears to be more important than the present way of analyzing their efficacy only through some isolated members [7, 30].

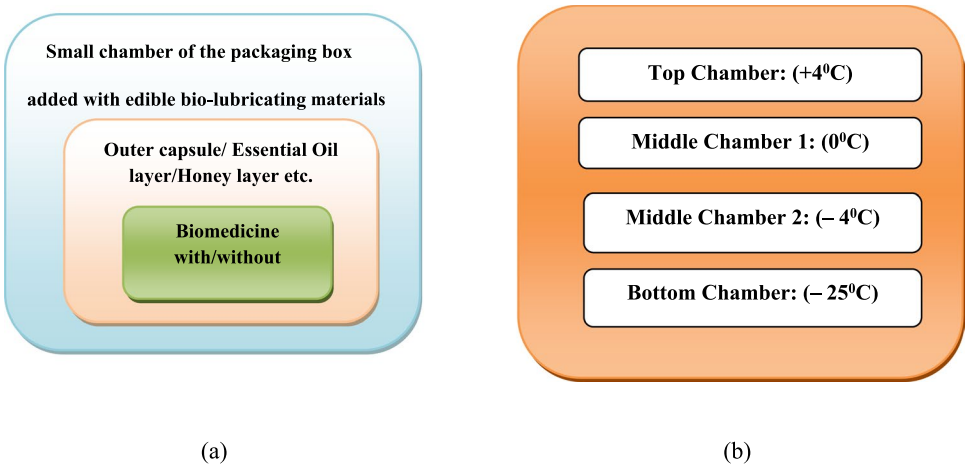


Fig. 2 Model of packaging of succulent biomedicines (**a**) and specialized freezing device for storage and dispensing of those medicines (**b**)

6.2 Possible ways followed by the succulent biomedicines to show their activities

Among the various possible ways followed by the biomedicines to show their activities, the main areas may be the following.

i. Most succulent biomedicine contains a wide number of important micronutrients and nutraceuticals. These can act together to modulate the body's immunity by influencing various genetic [45] and epigenetic factors [46–48].
ii. Modulation of the different segments of the non-specific immunity of the body can control both weak as well as overactive activities of the system [5, 49, 50].
iii. Modulation of the related arm of the immunity power of the body can be strengthened to combat microbial infections by the specific phytochemicals present in one or a few succulent biomedicines [5, 27, 30].
iv. A rejuvenation of the body systems (like the hormonal or enzymatic systems) can ultimately change the entire inner environment of the body. Succulent biomedicines are expected to have such activities. That is related to the '*Rasayana*' concept of the Indian ancient codified healthcare system - Ayurveda [7].
v. Exhibition of qualities like immunomodulation, antioxidation, anti-inflammatory, hepatoprotective, cardiotonic, hypercholesterolaemic, diuretic, anti-asthmatic, etc. of the succulent parts of the medicinal plants lead actually towards modulation of the entire immunity system of the body [7, 31, 32].
vi. As per the idea of modern medicine, the phytochemicals extracted from the dry parts of medicinal plants include flavonoids, carotenoids, polyphenols, ascorbate, etc. compounds - all are considered medicinally active and having modulation power on the body's immunity system. Such modulations in the body's immunity power can affect different health conditions, ranging from protection from infection by pathogens to cancers [7, 51, 52]. The effective phytochemicals are available in much more - both qualitatively and quantitatively in the succulent state of the plant parts [22, 32].
vii. Phyto-constituents present in the succulent biomedicines always act together, so their collective effects are expressed during their use. There may be some in-house effects like potentiation of the positive effect of one or suppression of detrimental effect of another by some other phtoconstituent/s present in the succulent biomedicines. On the other hand, isolated phytochemicals usually show toxicity in the possible individual therapeutic doses most of the time, as they act like synthetic compounds [22, 31, 32].
viii. Development of resistance among the microorganisms and parasites against the anti-microbial and anti-parasitic single molecule synthetic medicines is a very common problem encountered nowadays, as blocking the activity pathway by modification of the body system of the organisms is common in such cases. However, such resistance development against a wide range of phytochemicals present in the succulent biomedicines, working separately following various ways to show their activities may be very difficult or practically impossible for these invading microbes and other parasites [7, 22, 27].
ix. Vaccination can be used to cover a portion of the infective organism, like a virus or bacteria. However, it is not possible to vaccinate any individual against all types of infective organisms to incur protection against all kinds of

diseases of infective origin. Vaccination has a very limited role in controlling the diseases of non-infective origin. There are chances of a reversal of the attenuated or modified organisms to far stronger organisms or a transfer of genes may convert non-pathogenic organisms to the pathogenic one. Like all other synthetic chemicals, the chemicals used in the vaccines may have many side effects.

The use of immunity modifier phyto-medicines as a part of food or as succulent biomedicine capsules can overcome these problems of vaccination if used specifically [4, 5, 27].

x. Psyche, neuron, and endocrine gland functioning are closely related and have a strong influence on the overall body immunity [34, 35]. So, the effect of positive lifestyle practices causing mental relaxation has positive influences on body immunity, aging, and disease susceptibility.

6.3 Problems in the identification of all mechanisms of actions of the succulent biomedicines.

i. Modern medicines are mostly of synthetic or semi-synthetic origin and are generally studied as an item of a single chemical compound. But any single succulent biomedicine contains a very large number of compounds; some of which may be below the detectable limit.
ii. The study of a single compound in a research system is far easier than the study of a mixture of some compounds together, as found in succulent biomedicines.
iii. The study of the involvement of different receptors in showing the activity of succulent biomedicines may be far more complex due to their poly-component nature.
iv. Many succulent biomedicines are also considered and taken as some nutraceuticals. So, the study of their activity separately as a medicine, particularly in the poly-herbal mixture condition, is very difficult to explore.
v. A very diverse type of metabolic product can be available in the body from that type of biomedicines. Studying all of them together may be very difficult.
vi. Many biomedicines act slowly, so the instant effect of such medicines may not be found in the body system and thus cannot be identified instantly.
vii. The positive effect of succulent biomedicines can be compared with the negative effects of the xenobiotic residues entering our bodies. They all act slowly, but inevitably [22, 31].

7 Limitations of the proposed healthcare system

In the present-day lifestyle, the people of the temperate zone of the world are generally accustomed to meat and meat products with a small portion of vegetables in their daily diet. The people of the tarried zone of the globe tend to keep a maximum portion of cereals and their products in their diet. A very large section of people of tender ages is accustomed to processed food and synthetic chemical-added drinks. The use of plastics as food and drink containers is very common. Rising from bed in the morning is not practiced by a good section of people as they are accustomed to a different type of lifestyle [7, 22, 31]. Due to many such reasons, both following a designed lifestyle and eating a good amount of food of vegetable origin may not be an easy subject of adaptation, both physiologically and psychologically.

8 Practice of the proposed modifications in daily life

Modification of lifestyle including food-drink style can be performed at the individual level by everybody. Following a regular lifestyle, starting from maintenance of body clock, sunlight exposure, lone walking, etc. need no assistance from any other person. The practice of taking the succulent fruit mixture, nut mixture, vegetable mixture, etc. as well as frequent changing of food items in the diet, etc. mainly requires self-initiative. Following only these practices can reduce the chance of encountering diseases to a minimum. Encapsulated fruit, nut, etc. mixture can be prepared and made available easily following the basic principles, but therapeutic use of succulent biomedicines requires thorough adoptive research before their widespread applications [7, 22, 31].

9 Conclusion

Succulent biomedicines can show their efficacies by modulating the immunity power of the body through the supply of effective weapons to the immunity soldiers, by acting directly against the problem-creating reasons, or even by correcting the lacunae of the body system. In the presence of a favorable environment inside the body, these may show their activities at a better magnitude.

Along with correction of wrong food-drink habits (such as the exclusion of processed foods, chemical added foods, chemical drinks, nasty fats, and inclusion of fiber-rich foods, vegetables, fruits, etc. in the diet) and correction of other lifestyle-related factors like a violation of the body clock, and inclusion of positive factors in life - like exposure to sunlight, practice of Yoga, ample physical exercise, etc. in the daily routine, the initiation and progression of almost all diseases can be strongly influenced by modulation of the immunity power of the body. Regular intake of mixtures of succulent vegetables and fruits, dry fruits, and spices can combat most of the diseases, and the rest can be treated specifically by bio-encapsulated effective succulent biomedicines.

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Declarations

Competing interests The authors declare no competing interests.

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